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TEACHER EDUCATION STRAGIES IN INTERDISCIPLINARY TEACHING IN SCIENCE, MATHEMATICS AND TECHINICAL/VOCATIONAL CURRICULA. TEACHER EDUCATION STRATEGIES IN THE INTERDISCIPLINARY TEACHING OF SCIENCE, MATHEMATICS, AND TECHNICAL/VOCATIONAL CURRICULA

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Abstract

Educational development at the present time, and the year 2006 is characterized by two main aims: to enhance the content of education by making it more relevant and to improve the teaching/learning process.

In science, both these aims have given rise to a number of projects which have attempted to link together the concepts and principles into an interdisciplinary or unified whole. The curricular materials generally include materials (texts and kits) for the students and guides for the teachers, once these are worked out way in advance; often these are so closely tied to the project/curriculum that teacher not *directly* involved in the project concerned have been only marginally influenced. It has also been observed/noted that when the trial phase of the interdisciplinary project (during which intensive training of teachers takes place) is over, many of teachers found it difficult to sustain the rhythm of implementation for a variety of reasons, much lip-service has been paid to the fact that teachers are agents of change and that central to any development or innovation is the role that they must play in language about that change, but little has been done to develop a theoretical framework in support of this role. In this direct, Professional Development Laboratory, PDL, has been working feverishly to produce a *Model*.

Much teaching in the past emphasized *content*, today, the shift away from teaching facts to teaching skills pose a challenge if not a threat to all who are engaged in this enterprise.

Keywords: Technical, Vocational, Curricula

Introduction

Teaching is essentially a process of developing, clarifying, enlarging and presenting information ideas and meanings to others. It is simply causing the child to learn. Its ultimate aim is that of preparing people for life in the real world. The qualities and skills necessary to do this effectively is still a matter of considerable controversy. However, certain characteristics seem to be agreed upon as part of the reservoir of skills and dispositions that a teacher should possess. These include:

- Open-minded and faith in the ability of people to change;
- An ability to see thematic consistencies in diverse information with skills in organizing and communicating these differences;
- An ability to conceptualize many sides of a controversial issue;

- An ability to learn from experience;
- Empathy;
- Well developed cognition and meta-cognition;
- Personal motivation, enthusiasm and;
- Maturity.

Much depends on the teacher's ability to manipulate the classroom situation, which in turn depends on how much he knows of his subject areas, how much he understands children's needs in relation to those of their society, and how flexible he is and often to change.

In the planning and implementation of any teacher training program (teacher/adjunct), consideration must also be given to the needs and concerns of the student-teacher and to the fact that teaching styles areas diverse as learning styles and that the needs of the teacher change with time.

Interrelated Teaching

There is no precise definition of interrelated teaching but the term does imply some form of *linking* of bodies of knowledge together in a meaningful way. The real difficulty lies in locating the organizing centers of such an approach.

There are three possible approaches to interrelated teaching: interdisciplinary, multidisciplinary and trans-disciplinary. The first two use the subject or subject matter as focal points while the third uses situations as a basis for organizing the learning. There is a virtue in raising all three approaches with the aim giving students a functional knowledge of the interactions between the different factions and components and the constant evolutions of the natural and human environment of which they are part: Organizing teaching so that subjects are interdisciplinary is a complex undertaking, the magnitude of which cannot be overstated. It includes:

1. Willingness of teachers,
2. Learning/pairing of teachers per subject,
3. Curriculum outcomes,
4. Goals, objectives, standards, indications, lesson plans, evaluations, summative, and formative,
5. Project work,
6. Evaluation strategies,
7. Continuous insurance training and retaining,
8. Portfolio assessment,
9. Daily diary about the program,
10. Certificate of recognition,
11. Parent teachers, faculty meetings, assembly, outside resources, museums, visits, and trips,
12. Display of work.

While situations maybe used as the organizing centre of the curriculum these focusing on the *learner*, there are advantages in not completely discarding the classification of knowledge into disciplines. Disciplines have their own method and epistemology, and by their very nature of their specificity should be treated in such a way so as to preserve their impact on the systematic training of the mind. There is good reason for retaining them at a higher level though every effort should be made to de-emphasize the teaching information as an end in itself and to interrelate subjects by drawing on the various methodologies and explanatory theories of the disciplinary concerned.

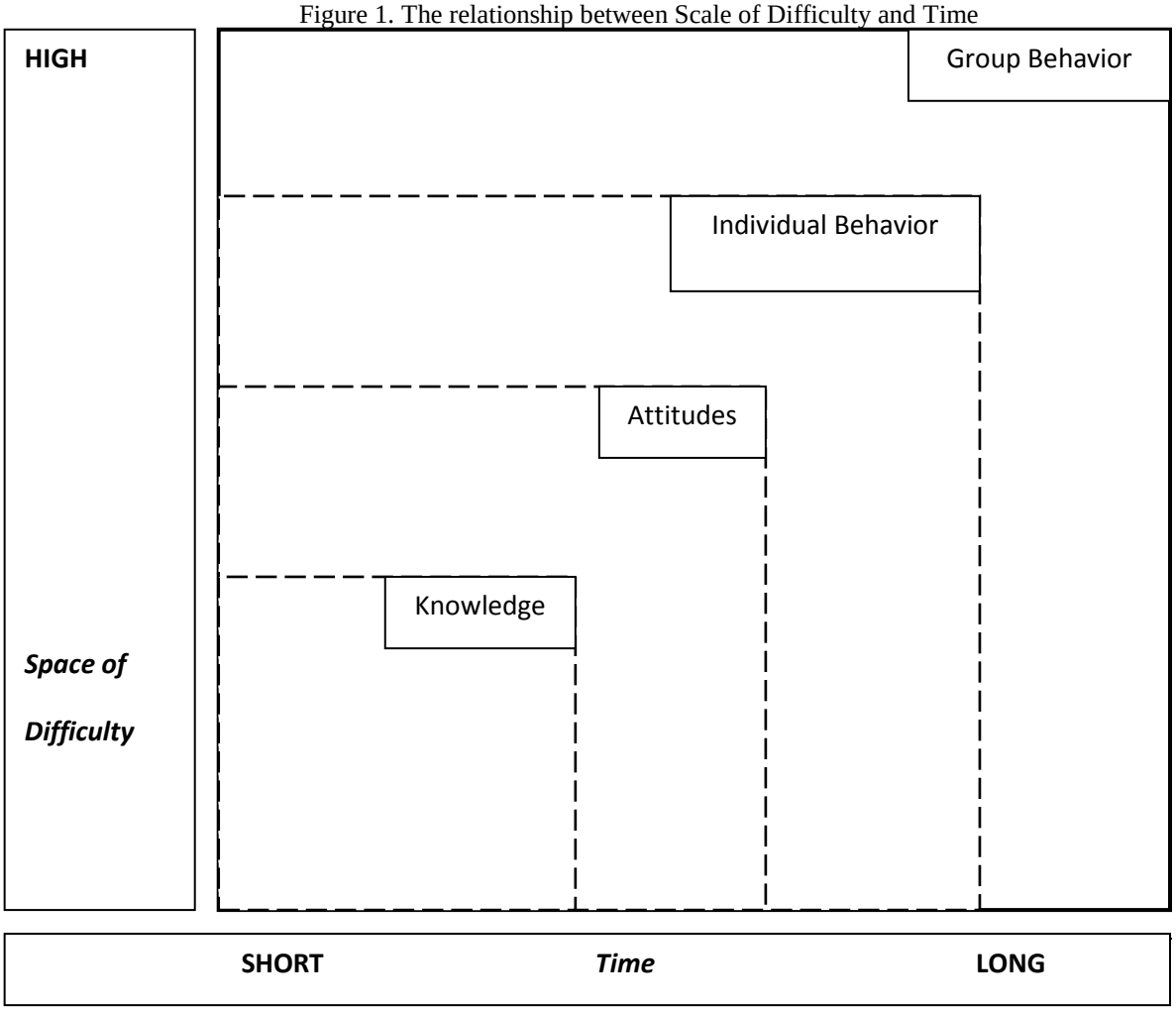
What do Interdisciplinary studies demand in Teacher Training?

Interdisciplinary studies demand intellectual breadth, knowledge and insight from college tutor, consultant and teacher trainee in training. In any cultural setting interdisciplinary studies in schools will contrast sharply with the status quo, the expectations tutors and students have of teaching, and the popular concept of schooling, its goals and outcomes.

The nature of the change/*approach interdisciplinary* presupposed a number of conditions they are:

- *Each teacher trainee has experience of a knowledge structure which interrelates the various disciplines.*
    a. The extent and depth of knowledge structure is greatly influenced by ability, schooling, and apprehension.
    b. Early constructs in the basis for more formal work of later schooling.
    c. The natural occurrence of interdisciplinary studies in the informal learning setting of clubs, museums, art and science centers for both children and adults provides a useful *models* of observation in interrelated knowledge in action.
- *For most students interdisciplinary studies demand a change in "experiences," that is, a change in the belief structure rather then a change in educational technique (pedagogy).*
    a. School is a place where one learns "subjects" where time is regulated by succeeding applied time of mathematics, science, social studies, art, etc.
    b. Conversion to another view of schooling will of necessity be slow and difficult to achieve. There maybe a resistance to the interdisciplinary approach.
- *Science and its mode of operation is in conflict with traditional thoughts, and will demand a change of view at both personal and professional levels.*
    a. Given this premise it is likely that interdisciplinary studies will present a challenge to an established way of thinking and will demand a change of view of many students and teachers.
- *Through the teaching of interdisciplinary studies it is believed that students will develop a knowledge structure relevant to experience and readily adaptive and transferable, and a diversity of concepts developed within the context of need to know rather then formal discipline.*
- *Supervised practice in conducting interdisciplinary studies in schools in a prerequisite to effective teaching.*
    a. Interdisciplinary teaching demands a change in attitude and behavior, both requiring time, and a support system with extends beyond the training period, it calls for a great deal of open-mindedness and mutual confidence and understanding.

Figure 1. The relationship between Scale of Difficulty and Time



Training of Teachers for Interdisciplinary Teaching – Teacher/Adjunct

In considering strategies needed, it will be necessary to distinguish between pre-service programs which teachers will be teaching. It is assumed that any program/project will include professional areas of Philosophy of Education, Sociology and Educational Psychology.

Organization of the Context – Teacher

The teacher should have the kind of background that reflects what science really is, a willingness to be innovative and certain competences which include:

1. A thorough knowledge of at least one of the sciences and a basic understanding of its interdisciplinary nature with the technical and vocational fields;
2. An ability t select and develop or implement curricular materials and strategies leading to desired behavior in the learner;
3. An understanding of the cultural values inherent in scientific activity;
4. An appreciation of the role that mathematics play in the understanding of reality;
5. An apprehension of the value of indigenous cultural roots;
6. Competencies in a variety of training-learning strategies and techniques including evaluation aimed at promoting the development of inquiry skills in learner;
7. Open-mindedness and flexibility in personal style that accommodations coping with change.

Since teachers will be entering the course from a variety of background and interests, it could be described to structure that content in the form of *modules* to allow for different entry points and to facilitate alternative routes through the program.

A common care of knowledge based on the "big ideas" or conceptual schemes of science way serve as the main branch with off-schools leading into the technical vocational fields.

***Ex*:** Energy, shape and pattern, materials and structures, time and space are same topics that way be used as *major themes* for interdisciplinary studies.

The materials chosen for curriculum development should interrelate varying bodies of knowledge, reflective world of work and be based on the 'scientific' approach.

There are three levels of curriculum materials:

LEVEL 1 – Individual Challenges

LEVEL 2 – Thematic Challenges

LEVEL 3 – Integrative/Interdisciplinary Challenges

These levels, which are arranged in hierarchical order, are aimed at developing creative thinking, one of the attributes required for interdisciplinary teaching. *Creative thinking* maybe said to comprise the ability to recognize problems, produce novel ideas, organize ideas and evaluate the results.

Ex:

Level 1: Design and use a trap to capture small animals

- A specific and small scale challenge
- Incorporate thinking and manipulative skills
- Knowledge of the phenomena to be investigated
- Relate to every day life situation
- Challenge embodies understanding at both the level of first hand experience and at conceptual level

Level 2:To design and construct a bridge 40cm long to hold at least 1kg using only wax paper and straws

- Requires group activity with problem solving in a social context – cooperative learning.

Level 3: Charcoal

- This is the most complex array of challenges
- Interdisciplinary – bring ideas together which are from varying fields of human knowledge
- Teachers/adjuncts can build a network of concepts and themes relevant to local situations.

Figure 2

Strategies of Delivery – Role of Teacher

How information acquired and delivered. A proposed strategy involves:

- Teacher/team (from school) undergoes training
- Adjunct/teacher (peer teaching) – discussion
- Team teaching a cross subject boundaries as a method of presenting the teacher with information through lectures, demonstrations, projects, seminars and workshops.
- Teacher will play an acute role-selecting topics and materials, teaching, and grading.
- Microteaching
- Use of video-taping, cassette tape
- Self teaching devices and video conferencing will play important roles.

The ability to read and communicate information part of the cognitive behavior of a scientist:

- Uniformity in the use of symbols; reduce confusion
- Teachers should know about particular readings in science and interdisciplinary readings.
- To write curriculum materials
- Training in the various models of communication

Strategies for evaluation

Feedback mechanisms designed for diagnostic and achievement purposes seem to be appropriate. Teacher need to develop confidence in their own ability to teach in the new way and to evaluate themselves – willing to make mistakes, free to experiment. Emotional stress needs to be reduced if the teacher is to be innovative and acquire self-confidence.

Continuous assessment through written papers, laboratory work, portfolio, project work including designing curricular units, making equipment from local materials, micro-teaching and peer group assessment are desirable. A credit system using profile ratings in recommended since these have advantages of high uplifting each faults of the multidimensional strengths which the new interdisciplinary approach demands

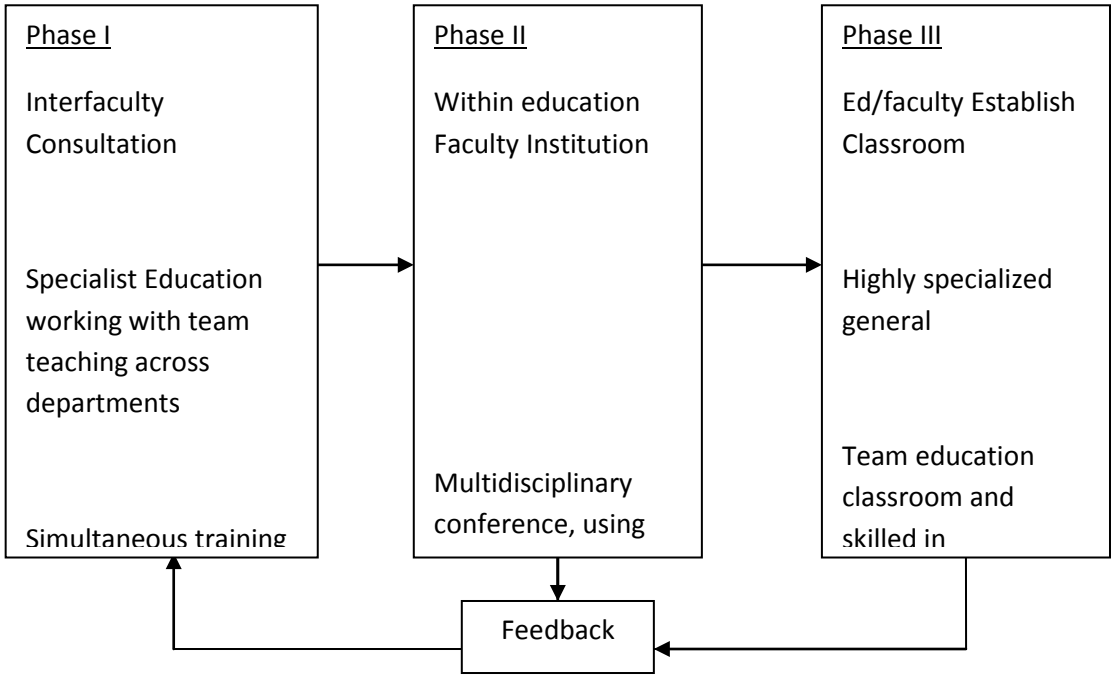
Implementation

Teaching in an interdisciplinary manner will require a reappraisal and restructuring of the in house school system

- Selection of students
- Teacher volunteer
- Programs
- Scheduling of teachers
- Back to back pairing
- Common prep time
- After school meeting initiations
- Grading
- Assembly
- Portfolio
- Budgeting and funding

Teachers play a central role in curriculum change. Not only will the proposed change affect pre and in-service training programs but a massive retraining of teacher will be necessary if we are to meet the challenges of education in the year 2006.

Figure 3: Implementation is engaged in stages or phases as interdisciplinary teaching evolves



Without practice and support little can be achieved in the long-term. Guided experiences in school and in training will be required. A base in context, pedagogy and sense of security and competence are important. Two teachers working together then provide to a common experience for cooperation, discussion and debate.

Implications

It is expected that interdisciplinary teaching may well disrupt the school system. However, the simultaneous training of teacher education and adjuncts together with cross fertilization provided by team work across department should act as stimulants rather than deterrents. Sunday school time-tables will need reorganization cooperation if the principal and staff are vital.

Since examination RCT/Regents have a powerful influence on teaching methods it maybe possible to capitalize on their influence by modifying them to include school-based assessment component in the form of projects.

There will be need for closer links between teachers of technical and vocational subjects and science and mathematics. At the moment, there is a tendency to view the technical – vocational subject as inferior to science and mathematics. The areas of study should be seen as complementary of teachers themselves make a conscious effort to work together as a team it is highly probable that the artificial barrier will begin to break down. Teachers cannot operate in water tight compartments and cellular and molecular biology requires an understanding of fundamental chemistry.

Science teachers' education/research programs should be utilized and the skills acquired put into practice fully. The use of indigenous materials and low cost equipment is worth the while considering.

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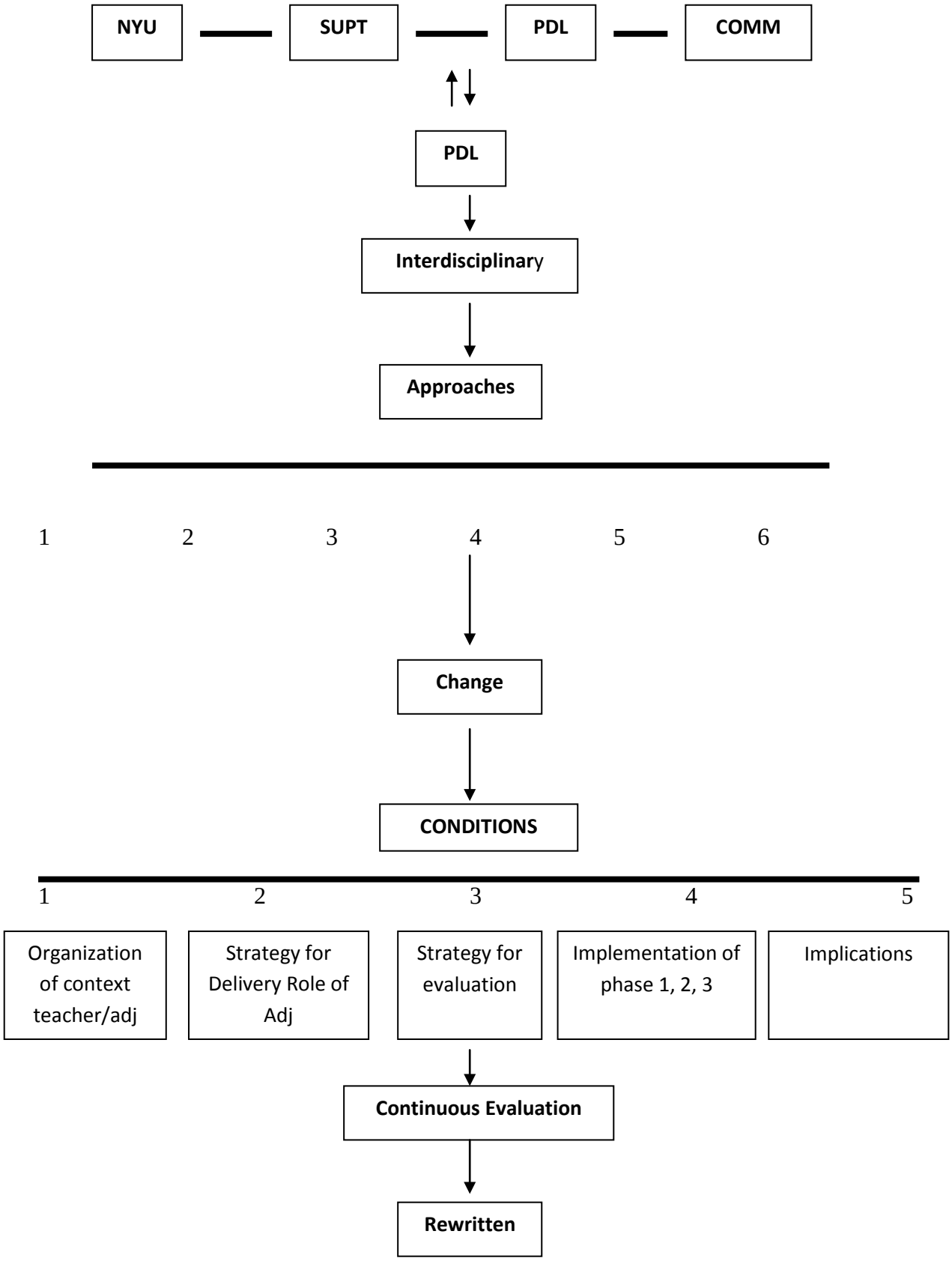
Flow Chart


NYU
SUPT
PDL
COMM
PDL
Interdisciplinary
Approaches
1 2 3 4 5 6
Change
CONDITIONS
1 2 3 4 5
Organization of context teacher/adj
Strategy for Delivery Role of Adj
Strategy for evaluation
Implementation of phase 1, 2, 3
Implications
Continuous Evaluation
Rewritten